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November 9, 1993

By Hand

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW
Washington, DC 20554

Re: Ex Parte Presentation
CC Docket No. 92-297

Dear Mr. Caton:

On behalf of Suite 12 Group ("Suite 12"), petitioner in the above-referenced proceeding, enclosed please find two (2) copies of a series of filings which were submitted by Hye Crest Management, Inc. ("Hye Crest"), a wholly owned affiliate of Suite 12, in a proceeding in which the Commission in 1991 granted Hye Crest a commercial point-to-point microwave license in the 28 GHz band for the New York Primary Metropolitan Statistical Area. Under that license, the CellularVision technology has been further refined, and Hye Crest currently offers a high quality, low cost alternative video service to residents in Brighton Beach, Brooklyn, an area which is not wired for cable television.

The Hye Crest filings address a number of technical characteristics about the CellularVision system that were carefully reviewed as a necessary predicate to the Commission's grant of the Hye Crest license. We recently determined that these relevant filings were not incorporated into the record in the Local Multipoint Distribution Service rulemaking proceeding, and therefore we are adding them to the record since they provide further evidence of the technical soundness of the CellularVision technology.

The Hye Crest filings that we are submitting include the following: Response, dated October 14, 1988; Cover Letter and Amendment, dated January 26, 1989; and Response, dated March 24, 1989. Please place these two copies of this set of Hye Crest filings in the above-referenced docket.

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Please direct any questions regarding this matter to the undersigned.

Sincerely,

Michael R. Gardner
Charles R. Milkis
Counsel for Suite 12 Group

Enclosures

cc Thomas Tycz, Deputy Chief, Domestic Facilities Division
Robert James, Chief, Domestic Radio Branch
Harry Ng, Senior Engineer, Satellite Radio Branch
Susan E. Magnotti, Esq.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In Re Application of	
HYE CREST MANAGEMENT, INC.	
License for New Station in the Point-to-Point Microwave Radio Service in 27.5 - 29.5 GHz Band Toward Various Points in the State of New York	File No. 10380-CF-P-88

RESPONSE OF HYE CREST MANAGEMENT, INC.

George Y. Wheeler
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Washington, D.C. 20036
(202) 467-5700

Its Attorney

October 14, 1988

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ATTACHMENTS

SUMMARY

Hye Crest Management, Inc. strongly opposes the requests of Bell Atlantic, BellSouth, NSMA, NYNEX and Southwestern Bell for deferral, dismissal or denial of its application. The claims made by these companies and other parties that Hye Crest is proposing a reallocation of 28 GHz spectrum misconstrues the scope of Hye Crest's application and the compelling public benefits which would be fostered by grant of the application.

Contrary to the arguments of Southwestern Bell, the public benefits of video channel services competitive with cable television in New York City are well documented. The City of New York, NYNEX and the other companies filing comments here have argued forcefully in the Telephone-Cable Television Cross-Ownership Proceeding that such competition is needed. Our application, as supplemented here, demonstrates the public benefits to be provided such as: spurring needed expansion of cable television in New York; extending service to as yet uncabled areas of the city; furnishing alternative coverage and channel capacity exceeding the capabilities of other alternative video delivery services; providing programming diversity capabilities to meet individual community needs; and using innovative technology to employ previously unused spectrum.

The engineering and design of Hye Crest's system reasonably and efficiently reflects its service needs to be competitive in the New York market in terms of channel capacity, cost effectiveness and availability of spectrum. The proposed frequencies are unused

in this area, have adequate bandwidth to accommodate channel capacity/quality to be fully competitive with existing cable television and can be operated in a spectrally efficient manner employing omni-directional antennas.

Hye Crest's use of 28 GHz spectrum will not deprive common carriers serving the market area of needed point-to-point microwave spectrum. A thorough analysis of the available microwave spectrum prepared for NYNEX and submitted by that company in Civil Action No. 81-0192 before the U.S. District Court for the District of Columbia confirms that there is adequate spectrum to meet foreseeable demands for point-to-point service without need for recourse to the 28 GHz spectrum requested by Hye Crest. In the event that co-channel 28 GHz operations would ever become necessary, however, the operations of Hye Crest would not preclude compatible point-to-point uses even within the service areas of its proposed facilities.

The designated service area approach to licensing was requested to permit Hye Crest the flexibility to design for re-use of frequencies given the relatively short usable range of 28 GHz frequencies, at the same time providing adequate coverage and channel capacity. By using a consistent plan of site, frequency, polarization and power level selection, important spectral efficiencies can be achieved. Existing licensing procedures under Section 21.711 or 21.41 could be employed to implement this approach without prejudice to the legitimate interests of potential point-to-point users. The concerns expressed by certain parties

regarding adequate procedures for frequency coordination are not a barrier to grant of Hye Crest's proposal.

Designation of non-common carrier status was requested so that Hye Crest could respond flexibly to consumer needs. It is also appropriate because of the extensive competition among video delivery systems in the New York City market which make direct common carrier regulation unnecessary in this instance. Southwestern Bell's arguments misconstrue applicable Commission precedent in this area.

Contrary to the claims of certain parties, Hye Crest's request for waivers offers a sound and efficient means for the Commission to make spectrum management decisions here. The public need for competitive service in the New York City area, the carefully crafted engineering parameters of Hye Crest's proposal, the continued ability of point-to-point users to meet their foreseeable needs, all strongly support grant here. Such a grant would not "prejudice" consideration of future similar waivers requests, if any. It would also avoid the need for long and cumbersome rulemaking proceedings which will only delay the implementation of needed service to the public without any assurance of corresponding benefits to be achieved by such delay.

Claims that any license granted to Hye Crest should not be "grandfathered" undercut the competitive viability of its proposal and should be rejected. Nor should its proposal be considered developmental for the same reason. Experimental operations of Hye Crest's equipment pursuant to Commission authorization have been

completed. Hye Crest is now proposing a new commercial service, on which the public has the right to rely for continued service.

For the reasons outlined here (and as supported in additional detail herein), Hye Crest requests that the Commission deny the relief requested by the parties here and grant its application.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In Re Application of	)	
	)	
HYE CREST MANAGEMENT, INC.	)	
	)	
License for New Station in the Point-to-Point Microwave Radio Service in 27.5 - 29.5 GHz Band Toward Various Points in the State of New York	)	File No. 10380-CF-P-88

RESPONSE OF HYE CREST MANAGEMENT, INC.

Hye Crest Management, Inc., (Hye Crest) herewith by its attorneys, responds to the comments filed on September 16, 1988 with respect to the above-captioned application.[1]

We strongly oppose the requests of Bell Atlantic, BellSouth, NSMA, NYNEX, and Southwestern Bell for deferral, dismissal or denial of our application. As discussed in detail here, these requests are unjustified, misconstrue applicable Commission policy and are contrary to the public interest in the expansion of competitive service offerings benefitting the public and the promotion of technological innovation. The above-captioned application should be granted in the public interest.

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[1] Comments of the Bell Atlantic Telephone Companies (Bell Atlantic); Informal Objection of BellSouth Corporation (BellSouth); Informal Comments of the Mountain States Telephone and Telegraph Company (and affiliates) (MTN); Comments of National Spectrum Managers Association, Inc. (NSMA); Comments of the NYNEX Telephone Companies (NYNEX); and Comments of Southwestern Bell Telephone Company (Southwestern Bell).

1. THE VIDEO CHANNEL SERVICES PROPOSED BY HYE CREST WILL YIELD SUBSTANTIAL PUBLIC BENEFITS FOR CONSUMERS IN NEW YORK CITY.

Contrary to the claims of Southwestern Bell, there is a substantial public need for competitive offerings of multi-channel video services in the New York SMSA. In its Comments in CC Docket No. 87-266, the Telephone Company-Cable Television Cross-Ownership Proceeding, the City of New York argues forcefully for expanded competitive entry in the cable marketplace citing the need to "spur an increase in the variety and technological sophistication of cable offerings," among other matters (Comments in CC Dkt No. 87-266, PP.5-6). NYNEX also filed reply comments in that proceeding stating that ". . . entry of new competitors into the CATV market can ensure that the benefits of greater diversity, better service and lower prices are available to consumers" and specifically confirmed its agreement with foregoing comments of the City of New York. (Reply Comments in CC Dkt No. 87-266, P.4). These comments plainly support the public need for competitive service offerings here and were relied upon recently in Commission's findings in that docket with respect to preserves a competitive broadband marketplace[2].

The Comments of several other parties in CC Dkt No. 87-266 also underscore the public need for the competitive video services proposed by Hye Crest. For example, Bell Atlantic stated that ". . . the cable industry needs more competition, not less."

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[2] Further Notice of Inquiry and Notice of Proposed Rulemaking in CC Dkt 87-266, released September 22, 1988, Paragraph 20.

(Comments in CC Dkt No. 87-266, P.3). BellSouth argued in favor of telephone company entry into the cable television market citing the benefits of "consumer gains . . . including a wider array of choices and lower prices." (Comments in CC Dkt No. 87-266, P.6). Even Southwestern Bell, which questions the public need for video channel services to be provided by Hye Crest, argued that the provision of such services "by telephone companies" should be permitted in the interest of ". . . encouraging competition, promoting technological innovations, and facilitating the offering of communications services to the American consumer." (Comments in CC Dkt No. 87-266, P.12).

Considering the foregoing arguments for modification of longstanding Commission policies barring telephone company - cable television cross-ownership restrictions based the need for competitive entry in the cable television industry, Southwestern Bell's arguments here appear to be self-serving and more than a little disingenuous. The Commission should also note that NYNEX, the only telephone company filing here with operations in the State of New York, made no claim that competitive video channel services were not needed.

While public benefits of introducing new competitors into the cable television market as identified above are well documented in a number of Commission proceedings, the tangible benefits of competitive service in terms of the needs and interests of consumers in the New York City area should also be addressed. Hye Crest intends to offer video channel services which will be

customized to meet the needs of individual submarkets within each of the five boroughs, will be highly cost competitive with alternative video channel services, and will be flexibly configured to be able to serve new subscribers without extended construction delays.

a. Grant of the Hye Crest Proposal will spur expansion of cable television in New York and provide a reliable source of channel services in uncabled areas.

One of the benefits anticipated from the grant of Hye Crest's proposal is a badly needed competitive spur to lagging installation of cable television in the New York City area and alternative video channel service in uncabled areas. In the New York SMSA, at least 1.6 million households[3] of a total of 3.6 million households[4] are not passed by cable.

Cable television construction has lagged because of long delays in franchise negotiations, political controversy, higher installation and operating costs, and complicated logistics with utility companies.[5] With New York being the largest urban market

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[3] Cable Television Franchising, PKA, 1/29/88 P.4.

[4] Housing Profiles SMSA Totals, CACI'S 1987 Sourcebook of Demographics and Buying Power for Every County in the USA, P.54-c.

[5] "Urban markets are by definition dense and congested which generally hamper attempts to wire and construct cable lines, as well as delay service repair runs. They also tend to have a tougher, more sophisticated and cynical political process and press." Amos Hostetter, CEO of Continental Cablevision Inc. in "Urban Markets: Directions for the '90s;" seminar sponsored by the National Cable Television Association and National Association for Minorities in Cable, September 28, 1988.

in the country, these problems are intensified. Even though construction finally has begun in some parts of New York (outside Manhattan), it is expected to take another five years or more to complete.[6] This situation underscores the public need for expanded alternative sources of video programming services here.

b. Hye Crest's Proposal will provide alternative coverage and channel capacity to consumers in New York fully competitive with cable television and exceeding the capabilities of other programming sources.

To compete effectively with cable delivery in any market area, an alternative video distribution system must be able to deliver comparable or better service features within the competing cable television company's service area. As determined in a study commissioned by the National Cable Television Association,[7] the most important service features include: Number of basic channels; Number of pay channels; Installation charges; Monthly price; and Technical reception quality.

The Hye Crest 24 channel video system proposes to provide a level of choice to all New York households that will satisfy the public need for expanded program diversity. An example of the kind

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[6] Contract Between Cablevision Systems New York City Corporation (The Bronx) and the City of New York, Appendix N, Schedule of Construction, P.27. A similar contract was entered by the same parties to cover the provision of cable television in Brooklyn.

[7] "Cable and Competing Technologies, A Conjoint Model of Consumer Choice;" Opinion Research Corporation for the National Cable Television Association.

of multi-interest programming mix that a 24 channel service can offer includes:

1. first run movies (Pay television)
2. health information
3. home and car repairs
4. educational courses
5. religious programming
6. a shop-at-home channel
7. congressional coverage
8. documentaries on different topics such as science and history
9. soap operas
10. programming for Hispanics
11. programming for Blacks
12. programming for women
13. country music
14. classic movies
15. a lifestyle channel showing trends and features about interesting people
16. a cultural channel featuring symphony, ballet, opera, and other performing arts events (Pay television)
17. quality children's programs (Pay television)
18. repeats of old television series programs
19. up-to-the minute stock prices and financial news
20. weather information
21. popular music
22. in-depth news
23. up-to-the minute headline news
24. sports (Pay television)

Twelve broadcast channels[8] will also be provided via reception equipment at each subscriber location via rooftop or master antenna system.

The combined 36-channel capacity to be provided by Hye Crest will be fully competitive in terms of quantity and quality to the

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[8] WCBS-2, WNBC-4, WNYW-5, WABC-7, WOR-9, WPIX-11, WNET-13, WLIW-21, WNYE-25, WNYC-31, WXTV-41, WNJU-47.

service customarily provided by cable television systems.[9] A majority of the 2.0 million New York SMSA households already served by cable television have access to 36 channels of service.[10] For these households, Hye Crest will offer a fully competitive alternative service at competitive prices for installation and monthly fees. For the approximately 1.6 million households not served by cable, Hye Crest's proposal will provide for many of these households the first competitive service to offer the number of channels which have previously been available exclusively via conventional cable television.

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[9] Of the 7,836 cable systems across the country, the majority of cable systems provide between 30 and 53 programmed channels.

PROGRAMMING CHOICES	# OF SYSTEMS	SUBSCRIBER PENETRATION
54 & OVER	565	14.85
30-53 **	3,272 **	62.17 **
20-29	1,298	14.03
13-19	312	1.29
6-12	1,557	5.76
5 ONLY	38	0.03
SUB 5	10	0.23
N/A	784	1.64
	7,836	100.00%

The above table demonstrates that more of the public will subscribe to a system with 30-53 channels than systems which carry less than 30 channels. The 30-53 channel group is the group with the highest subscriber penetration of all the groups listed, suggesting that the range of 30 to 53 channels is the minimum channel capacity needed to satisfy the public.

[10] 1987 Television & Cable Factbook, Television Digest and New York State Franchised Municipalities, NY State Cable Commission, 4/1/87 and 1987 Annual Information Survey: Cable Facts - Data for Cable Companies operating in New York State as of 4/1/87, NY State Cable Commission and Cable Facts, Office of Cable Television - State of New Jersey.

c. Hye Crest's Proposal Provides Consumer Benefits Which are Unmatched by Other Alternative Distribution Systems in the New York Area.

By providing channel capacity, signal quality and coverage comparable to cable television, Hye Crest will be able to offer its programming services in a manner which avoids some disadvantages and limitations which have diminished the public acceptance of other alternative video delivery systems.

In particular the NCTA Study referenced above assessed the potential impact of Direct Broadcasting Satellite (DBS) and Multipoint Distribution Systems (MDS) on the market for cable television systems. It concluded that the significantly lower installation charges and greater channel capacity of cable television gave it an overwhelming advantage over these delivery systems. For the reasons described above, Hye Crest will not be disadvantaged in this manner.

MMDS (together with associated ITFS channels) is also limited in its capacity to compete with cable television because of its line-of-sight propagation characteristics. It is estimated that these limitations preclude reception in approximately 10-15 percent of New York households.[11] As described in the Hye Crest application, this limitation is avoided by the grid or cell-type design of Hye Crest's proposed system which greatly diminishes or

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[11] See Crane's New York Business, "Cable TV Firm Hoping for Strong Signal," October 19, 1987, P.15; and Broadcasting, "Microband Brings Wireless to New York," November 23, 1987, PP.71-72.

eliminates this problem by reducing the potential path length to a subscriber location and by providing in some cases alternative transmit locations to optimize service quality.

Private cable operations, also known as Satellite Master Antenna Television (SMATV), may have sufficient channel capacity, but they require the installation of a satellite earth station and cable television headend at every apartment building they seek to serve. Consequently, their market is limited to apartment buildings with sufficient numbers of apartments and subscribers to be a cost-effective investment. This option eliminates many smaller buildings which are not served by cable television in Brooklyn and the Bronx.[12]

Sharing satellite antenna installations among several apartment buildings potentially can make SMATV more economically competitive with cable television but for practical reasons is infrequently accomplished. SMATV developers are limited in their ability to carry signals to other buildings because the only means of carrying video signals to buildings across public streets is optical laser transmission devices, which are only capable of 3000 foot paths with a clear line-of-sight. This means that SMATV operators are limited in the types of residential projects capable

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[12] Community District Needs - Fiscal Year 1989 - Bronx, Office of Management and Budget, Department of City Planning, The City of New York, October 1987, P.5, and Community District Needs - Fiscal Year 1989 - Brooklyn, Office of Management and Budget, Department of City Planning, The City of New York, October 1987, P.5.

of being served. Many small buildings do not have sufficient numbers of apartments to be cost-effective operations particularly in Brooklyn and the Bronx where these are the most prevalent building types. The Hye Crest system can efficiently and economically serve even these smaller residential installations.

d. Hye Crest's System Design Permits Diversified Programming Selection to be Made on the Basis of the Community Needs and Interests in the Service Area of Each Transmission.

In the New York SMSA, which has also been called a "melting pot," there are many different racial, religious and international groups living in clusters of varying sizes.[13] In areas that are served by a cable operator, it is the cable operator's business objective to provide programming which appeals to a majority of the people in the service area. Unfortunately, this objective frequently overlooks the specialized interests and needs of minority groups. Alternative delivery systems with limited channel capacity, such as DBS or MMDS, tend to favor entertainment-oriented channels over specialized programming. The proposed Hye Crest system has the capability of offering specialized programming to serve the specialized programming needs within each cell or transmit service area.

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[13] Atlas of the Census, A Portrait of New York City from the 1980 Census, City of New York, Department of Planning.

e. Grant of Hye Crest's Proposal will Help Promote and Accelerate Technological Innovation Leading to Diversified Uses of the 27.5 - 29.5 GHz and Other Millimeter Spectrums.

Grant of the Hye Crest proposal will permit the first commercial implementation of innovative technology to operate in the 27.5 - 29.5 band. The benefits to the public from such implementation will strongly promote and accelerate further innovations and refinements to make this technology highly cost efficient for video channel services and to make possible other uses, including non-video services, to be operated in the same band and in adjacent "millimeter" bands. By making available for use and encouraging expanded use of significant amounts of previously unused spectrum, the Commission will be meeting the fundamental goals of its legislative mandate in Section 1 of the Communications Act.

2. THE ENGINEERING AND DESIGN OF HYE CREST'S PROPOSED SYSTEM EFFICIENTLY AND REASONABLY ADDRESS THE COMMISSION'S SPECTRUM MANAGEMENT OBJECTIVES.

Southwestern Bell, BellSouth, NSMA and MTN raise questions regarding Hye Crest's selection of 28 GHz frequencies, the amount of bandwidth requested and the proposed use of omni-directional antennas. In this section we will respond to these comments to confirm that Hye Crest has efficiently and reasonably sought to meet its spectrum needs.

a. The 27.5 - 29.5 GHz Band has been Selected because it is the Most Suitable Band Available for Video Transmission.

Prior to undertaking its experimental evaluation of microwave equipment in the 28 GHz band, Hye Crest studied the availability of other frequency bands for omni-directional video distribution. The results of that study, described below, show that the 27.5 - 29.5 GHz band is the most suitable for video distribution.

The frequency bands below 13.25 GHz were immediately discarded because they were known to be widely used, and in some areas heavily congested. This includes the 2.6 GHz band allocated for ITFS/MMDS use. That left the following frequency bands that are listed in the Commission's Common Carrier (Part 21) and/or Private Operational/Fixed (Part 94) Microwave Services: 17.7-19.7 GHz; 21.2-23.6 GHz; 27.5-29.5 GHz; 31.0-31.3 GHz; and 38.6-40.0 GHz. Frequency bands above 40 GHz do not appear in Parts 21 or 94, and therefore were not considered.

The 17.7-19.7 GHz and 21.2-23.6 GHz bands were both found to be unsuitable. These bands have been used for about ten years, and frequencies throughout the band have been licensed for use in New York. While there is no congestion in these bands, it does not appear possible to find a contiguous band to support 24 video channels because of existing licenses.

One part of the 18 GHz band that is not being used is 18140-18580 MHz. This band is channelized into 6 MHz channels, and was intended for video distribution by cable television operators using

vestigial sideband AM modulation.[14] The channel plan was designed for cable television systems to distribute video from head-ends to hubs via multiple point-to-point links, as is the case with CARS local distribution service assignments.[15] Hye Crest investigated the technical feasibility of wide-beam video distribution using these 6 MHz channels. Hye Crest concluded that it was not possible both to achieve the high power needed to overcome the low gain of wide-beam antennas, and to achieve the highly linear amplification that is needed for VSB-AM modulation. Moreover, FM modulation is needed because of the 30 db FM enhancement which FM provides. Consequently, this part of the 17.7-19.7 GHz band is not suitable for Hye Crest's intended service.

The 31.0-31.3 GHz band was also found to be not suitable because it contains only 300 MHz, not enough for 24 frequency-modulated video channels. Moreover, the band is available for use without frequency coordination, and no protection is afforded from interference. Consequently, this band would not be suitable for Hye Crest's proposed service where high reliability would be needed.

The 38.6-40.0 GHz band is less suitable for wide-beam video distribution than the 27.5-29.5 GHz band. First, it contains only

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[14] First Report and Order in Gen. Docket No. 82-334, FCC 83-393, released September 30, 1983, at Paragraph 54; see also Memorandum Opinion and Order in Gen. Dockets 82-334 and 79-188, FCC 84-389, released August 17, 1984, at Paragraph 23.

[15] 47 CFR 78.5(b).

1400 MHz rather than 2000 MHz. Second, it is shared with portable transmitters that are now in use by TV broadcast stations and networks, rather than being allocated solely for fixed use. Finally, and most importantly, atmospheric attenuation is greater at this frequency than at 28 GHz, and consequently path lengths would be shorter than attainable at 28 GHz.[16] The 40 GHz band exhibits 4 dB per mile (16-20 dB per cell) more attenuation than 28 GHz for the same rainfall rate and is therefore not useful for the Hye Crest application.[17] This additional loss would result in a substantially greater number of cellular transmitters needed to cover an area, and would make the system economically unfeasible.

Consequently, of the potentially-available microwave bands, the 27.5-29.5 GHz band was selected as the most suitable for wide-beam video distribution. It is unused[18] and it contains enough spectrum so that only half the band is needed to carry 24 video channels. Technology exists so that adequate power may be

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[16] Free space loss increases as 20 Log (frequency in GHz). CCIR Report No. 563-1 (1975). The additional loss at 40 GHz compared to 28 GHz is therefore about 3 dB. This ignores the effect of rain or water absorption, which has a more complex frequency dependence. For a general discussion of propagation features of these microwave bands, see Notice of Inquiry in Gen. Docket No. 82-334, FCC 82-286, released July 9, 1982, at Paragraphs 10-16, and references cited therein.

[17] This assumes 99.9% availability in Region D2, and 15 mm/hr rain rate; at 28 GHz, the attenuation is 4 dB per mile while at 40 GHz it is 8 dB per mile.

[18] See Hye Crest Application, Supplemental Showing, Part 21.100(D), Comsearch, Inc., July 22, 1988.

generated at reasonable cost to achieve acceptable path lengths.

b. Amount of Bandwidth Requested was Selected to Provide for Reasonable Requirements for Video Transmission Capacity.

Hye Crest has requested the use of the 27.5-28.5 GHz band, a total of 1000 MHz. In light of technical and marketplace needs, and in the absence of alternative demand for this spectrum, the request is reasonable based on the delivery of 24 channels of video to apartments, hotels and homes. Section 1 describes the competitive circumstances which establish the requirement for distribution of 24 video channels.

The Hye Crest technical design is based on the use of FM modulation to transmit each video channel. Investigation of AM modulation at these frequencies shows that it may reasonably be used for point-to-point transmission, but is not suitable for use with wide-beam antennas. This is true because wide-beam antennas have a fairly low gain (6-12 dB) compared with point-to-point antennas (36-40 dB), and require a substantially higher power source (watts rather than milliwatts) in order to achieve acceptable path lengths. AM modulation requires a higher degree of linearity in the power source than FM. Unfortunately, the state of the art today does not support the level of linearity that is required for AM in a power source that can achieve several watts of power. Moreover, FM provides a 30 dB improvement in system gain. For this reason, the Hye Crest system design is based on FM modulation.